Mathematics KS4 Programme of Study

This document outlines the prescribed syllabus that students will be taught at Key Stage 4. The majority of students will work within the Functional Skills and Foundation tiers. Some students will begin their Key Stage 4 journey by reviewing Entry level work alongside Foundation topics. The most able students will follow a bespoke curriculum to allow them work within the Higher Tier.

KS4 Foundation Tier Glossary

Number

Factor - A factor of a product is a number that the product can be divided by exactly e.g. the factors of 6 are 1,2,3 and 6

Four operations – add; subtract; multiply; divide

Integers – whole numbers

Inverse operations – an operation that undoes a previous operation e.g. The **inverse** of addition is subtraction and vice versa. The **inverse** of multiplication is division and vice versa.

Multiple - a number that can be divided by a smaller number an exact number of times e.g. times tables are lists of multiples

Prime numbers – a number that is only divisible by itself and 1

Square numbers - the product of a number multiplied by itself, e.g. 1, 4, 9, 16

Square root - a number which produces a specified quantity when multiplied by itself."7 is a square root of 49"

Indices (powers)- An index number is a number which is raised to a power. The power, also known as the index, tells you how many times you have to multiply the number by itself. For example, 2^5 means that you have to multiply 2 by itself five times = 2×2×2×2×2 = 32.

Terminating decimals - A decimal number that has digits that end

Algebra

Binomial -A binomial expression is an algebraic expression consisting of two terms e.g.ax + b, $x^2 - y^2$, and 2x + 3y

Co-ordinate - A set of values that show an exact position. On graphs it is usually a pair of numbers: the first number shows the distance along, and the second number shows the distance up or down.

Equations - a statement that the values of two mathematical expressions are equal (indicated by the sign =)

Expressions- An expression is a sentence with a minimum of two numbers and at least one math operation e.g. 3y+4. It does not have an = sign

Formula- a mathematical relationship or rule expressed in symbols e.g. A = L x W

Identities - An equation that is true no matter what values are chosen. Example: a÷2 = a × 0.5 is true, no matter what value is chosen for "a"

Inequalities – An inequality compares two values, showing if one is less than, greater than, or simply not equal to another

Linear equation/ linear graph - an equation between two variables that gives a straight line when plotted on a graph.

Nth Term - The 'nth' term is a formula with 'n' in it which enables you to find any term of a sequence

Quadrant - the four quarters of the coordinate plane

Quadratic equation/ quadratic graph - A quadratic equation contains at least one term that is squared. The graph of a quadratic function is a parabola (curve)

Simultaneous equations- a pair of equations with two unknown variables - two unknowns require both equations be solved at the same time (simultaneously). -

Sequence- A sequence is an arrangement of any objects or a set of numbers in a particular order following a rule

Ratio

Direct proportion - There is a direct proportion between two values when one is a multiple of the other. For example, . To convert cm to mm, the multiplier is always 10.

Inverse proportion - Inverse proportion occurs when one value increases and the other decreases. For example, more workers on a job would reduce the time to complete the task. They are inversely proportional.

Linear function - A linear function has one independent variable and one dependent variable.

Percentage - a proportion that shows a number as parts per hundred. The symbol '%' means 'per cent'. 9% means 9 out of every 100, or. Percentages are just one way of expressing numbers that are part of a whole. These numbers can also be written as fractions or decimals**.**

Proportion -The number or amount of a group or part of something when compared to the whole. Two quantities are in direct proportion when they increase or decrease in the same ratio. For example, you could increase something by doubling it, or decrease it by halving.

Multiplicative - tending or having the power to multiply.

Ratio - A ratio shows how much of one thing there is compared to another. Ratios are usually written in the form a: b.

Scale factor - The ratio of corresponding lengths in similar shapes, ie how much larger or smaller the shapes are.

Probability

Mutually exclusive - Mutually exclusive means that the two outcomes of the same event cannot happen at the same time. The outcome of a football match is an example of something that is mutually exclusive as the match is either won, lost or drawn, it cannot be both won and drawn at the same time.

Probability- is the likelihood or chance of an event occurring.

Tree diagrams - Tree diagrams are a way of showing combinations of two or more events. Each branch is labelled at the end with its outcome and the probability is written alongside the line. Two events are independent if the probability of the first event happening has no impact on the probability of the second event happening.

Venn diagram - A Venn diagram (named after mathematician John Venn in 1880) is a method used to sort items into groups.These diagrams are usually presented as two or three circles overlapping, with the overlapping sections containing items that fit into both (or all, if three circles overlap) groups. Items which don't belong to either/any group are placed on the outside of the circles.

Geometry

Congruence - Two shapes are congruent if they are the same (shape and size)- in other words, if the lengths of the sides and the angles are the same.

Loci - A locus is a path formed by a point which moves according to a rule. The plural is loci. The runner is following a path. This path is a locus.

Perpendicular - Perpendicular means "at right angles". A line meeting another at a right angle, or 90° is said to be perpendicular to it.

Similarity -Having the same shape but not necessarily the same size. The corresponding angles within the shapes are equal.

Vertices - A vertex (plural: **vertices**) is a point where two or more line segments meet. It is a Corner.

Vector -A vector describes a movement from one point to another. A vector quantity has magnitude (size) and direction.

Statistics

Continuous data - Continuous data is data that can be measured and broken down into smaller parts and still have meaning. Money, temperature and time are continuous.

Discrete data - Discrete data involves round, concrete numbers that are determined by counting.

Frequency table - Frequency refers to the number of times an event or a value occurs. A frequency table is a table that lists items and shows the number of times the items occur.

Grouped data -grouped data is data that has been organized into groups from the raw data.

Interpolate / extrapolation -Extrapolation is an estimation of a value based on extending a known sequence of values or facts beyond the area that **is** certainly known. ... **Interpolation is** an estimation of a value within two known values in a sequence of values.

Mean - is the average of the numbers: a calculated "central" value of a set of numbers. To calculate it: add up all the numbers, then divide by how many numbers there are.

Median -The "middle" of a sorted list of numbers. To find the Median, place the numbers in value order and find the middle number. Example: find the Median of {13, 23, 11, 16, 15, 10, 26}. Put them in order: {10, 11, 13, 15, 16, 23, 26} The middle number is 15, so the median is 15. (When there are two middle numbers we average them.)

Mode - The mode is the number that appears the most in a set of data.

Pictogram -A pictogram is a chart or graph which uses pictures to represent data. They are set out the same way as a bar chart but use pictures instead of bars. Each picture could represent one item or more than one.

Range -The Range (Statistics) The Range is the difference between the lowest and highest values. Example: In {4, 6, 9, 3, 7} the lowest value is 3, and the highest is 9. So the range is 9 − 3 = 6.

KS4 Higher Tier Glossary

Cubic equation- Whereby the highest power of any variable is 3 ($x^3 + x^2 – 3x – 4$)

Denominator- The bottom number in a fraction

Equation- A statement containing an = sign to show that both sides are equal in value (4x -2 = 10)

Error Interval- The range of values a number could have taken before being rounded

Expand- To multiply out the brackets in an expression

Expression- A collection of terms connected by operations to show an overall function (2x + 3)

Factor- The numbers which divide exactly into a number (factors of 12 = 1, 2, 3, 4, 6 & 12)

Factorise-To find common factors of a term & insert brackets into an expression

Formula- A rule containing 2 or more variables

Function- The result of applying an operation or sequence of operations to a variable

Geometric progression - A list of numbers that is multiplied/divided by the same amount each time

Identity- An identity relates one expression to another, where both expressions contain variables ($2x + 4 + x - 2 \equiv 3x + 2$)

Inequality- A statement comparing 2 values ($3x + 4 > 10$)

Improper fraction- A fraction where the numerator is larger than the denominator (3/2)

Integer- A whole number (positive or negative)

Iteration- When a function is repeated, using the output of the previous step as the input for the next

Linear equation- Whereby no variable is raised to a power greater than 1 ($2x + 4$)

Linear progression-A list of numbers that increases/decreases by the same amount each time

Multiple- The result of multiplying a number by any other number (multiples of 4 = 4, 8, 12, 16…)

Mixed number- A combination of a whole number & a fraction (3 ½)

Numerator- The top number in a fraction

***n*th term**- The value of any term in a sequence

Perpendicular- Crossing or meeting at a right angle

Prime number- A number which has exactly 2 factors – itself & 1

Product- The result of multiplying 2 or more numbers together

Proof- Use of mathematical, algebraic or geometric rules and methods to show the logical argument behind the solution to a problem

Quadratic equation- Whereby the highest power of any variable is 2 ($3x^2 + 2x - 4$)

Quadratic progression- A list of numbers whereby the next term is produced by multiplying the previous term by itself

Reciprocal- The result of dividing 1 by the given number (the reciprocal of 3 is 1/3)

Recurring decimal-A decimal number, where one or more of the digits is repeated indefinitely (1.323232…)

Rearrange- To use inverse operations to make another variable the subject of a formula

Simplify- To condense an expression by grouping/combining similar terms

Solve/evaluate -To find the value of an unknown/variable

Substitute- Replace variable(s) in a formula with a known value in order to find other value(s)

Subject - The single variable in a formula which is expressed in terms of other variables (e.g. in the formula $E = mc^2$, E is the subject)

Surd- A number that can't be expressed accurately, as it is a non-terminating decimal, and is therefore written in the form of a square root, e.g. √2, √5, √6

Term- A single number, variable or multiple of a variable (e.g. 3, a, 4a, 2ab)

Turning point- The lowest/highest point of a quadratic graph

Truncation- A method of giving an estimated value of a number by dropping decimal places without rounding

Unknown- A number of unknown value – represented algebraically by a letter

Upper/lower bound- The largest/smallest possible values of a number before rounding

Variable- A quantity (represented by a letter) that may change in value

Key Stage 4- Number

Entry Level- learners working below GCSE level	**Functional Skills-** interlink with Foundation FS 1 / FS 2	**Foundation** Review of KS3 and linked with Functional skills	**Higher-** developing skills from Foundation for most able
Component 1 -To be able to read, write, order and compare numbers up to 1000 and recognise place value. -To be able to round numbers to the nearest 10,100,1000. -To be able to recognise and use multiples of 2,3,4,5,8,10,50& 100. Component 2 -To be able to add and subtract up to 3 digit numbers. -To be able to multiply and divide 2 digit by 1 digit numbers and use and recall multiplication facts. -To use inverse operations to find missing numbers -To be able to use and interpret +,-,x,÷& = in real life situations for solving problems Component 4 To be able to calculate amounts and give change	NS1 Read, write, order and compare large numbers (up to one million) NS2 Recognise and use positive and negative numbers NS3 Multiply and divide whole numbers and decimals by 10, 100, 1000 NS4 Use multiplication facts and make connections with division facts NS6 Calculate the squares of one-digit and two-digit numbers NS7 Follow the order of precedence of operators NS18 Read, write, order and compare positive and negative numbers of any size NS19 Carry out calculations with numbers up to one million including strategies to check answers including estimation and approximation	**Number** N1 order positive and negative integers, decimals and fractions. N2 apply the four operations, including formal written methods, to integers, decimals and simple fractions N3 use inverse operations N4 use the concepts and vocabulary of prime numbers, factors (divisors), multiples, common factors, common multiples, highest common factor, lowest common multiple, N5 apply systematic listing strategies N6 use positive integer powers and associated real roots (square, cube and higher), recognise powers of 2, 3, 4, 5 N7 calculate with roots N8 calculate exactly with fractions and multiples of π N9 calculate with and interpret standard form	**Number** N1use the symbols =, ≠, <, >, ≤, ≥ N2 apply using mixed numbers – all both positive and negative; understand and use place value N3 use conventional notation for orderof operations, including brackets, powers, roots and reciprocals N4Express a number as a product of its prime factors N5Multiply the number of outcomes for each event to find the total number of combinations N6estimate powers and roots of any given positive number N7 calculate with fractional indices N8calculate exactly with surds and simplify surd expressions involving squares (e.g. √12 = √(4 × 3) = √4 × √3 = 2√3) and rationalise denominators N9calculate with and interpret standard form A × 10n, where 1 ≤ A < 10 and n is an integer

Key Stage 4- Number continued

Entry Level- learners working below GCSE level	**Functional Skills-** interlink with Foundation FS 1 / FS 2	**Foundation** Review of KS3 and linked with Functional skills	**Higher-** developing skills from Foundation for most able
Component 3 -To be able to understand equality -To be able to identify and show halves, thirds, quarters, fifths and tenths. -To be able to recognise and identify equivalent fractions -To be able to add or subtract fractions with a common denominator	NS8 Read, write, order and compare common fractions and mixed numbers NS9 Find fractions of whole number quantities or measurements NS10 Read, write, order and compare decimals up to three decimal places NS11 Add, subtract, multiply and divide decimals up to two decimal places NS16 Recognise and calculate equivalences between common fractions, percentages and decimals NS13 Read, write, order and compare percentages in whole numbers NS21 Identify and know the equivalence between fractions, decimals and percentages NS22 Work out percentages of amounts and express one amount as a percentage of another NS23 Calculate percentage change (any size increase and decrease), and original value after percentage change NS24 Order, add, subtract and compare amounts or quantities using proper and improper fractions and mixed numbers NS25 Express one number as a fraction of another NS26 Order, approximate and compare decimals NS27 Add, subtract, multiply and divide decimals up to three decimal places NS12 Approximate by rounding to a whole number or to one or two decimal places NS15 Estimate answers to calculations using fractions and decimals	**Fractions, Decimals and Percentages** N10 work interchangeably with terminating decimals and their corresponding fractions N11 identify and work with fractions in ratio problems N12 interpret fractions and percentages as operators **Measures and accuracy** N13 use standard units of mass, length, time, money and other measures N14 estimate answers; check calculations using approximation and estimation N15 round numbers and measures to an appropriate degree of accuracy	**Fractions, Decimals and Percentages** N10 change recurring decimals into their corresponding fractions and vice versa **Measures and accuracy** N15 use inequality notation(>, ≥, <, ≤, ≠) to specify simple error intervals due to rounding N16 apply and interpret limits of accuracy, including upper and lower bounds

Key Stage 4- Algebra

Entry Level- learners working below GCSE level	**Functional Skills-** interlink with Foundation FS 1 / FS 2	**Foundation** Review of KS3 and linked with Functional skills	**Higher-** developing skills from Foundation for most able
	NS20 Evaluate expressions and make substitutions in given formulae in words and symbols NS29 Follow the order of precedence of operators, including indices	**Notation, vocabulary and manipulation** A1 use and interpret algebraic manipulation A2 substitute numerical values into formulae and expressions A3 understand and use the concepts and vocabulary of expressions, equations, formulae, inequalities, terms and factors A4 simplify and manipulate algebraic expressions by: collecting like terms, multiplying a single term over a bracket, taking out common factors, expanding products of two binomials ,factorising quadratic expressions, including the difference of two squares; simplifying expressions involving sums, products and powers, including the laws of indices A5 understand and use standard mathematical formulae; rearrange formulae to change the subject A6 know the difference between an equation and an identity A7 where appropriate, interpret simple expressions as functions with inputs and outputs. **Graphs** A8 work with coordinates in all four quadrants A9 plot graphs of equations that correspond to straight-line graphs in the coordinate plane; use the form y = mx + c to identify parallel lines. A10 identify and interpret gradients and intercepts of linear functions graphically and algebraically A11 identify and interpret roots, intercepts, turning points of quadratic functions graphically; deduce roots algebraically A12 recognise, sketch and interpret graphs of linear functions, quadratic functions, simple cubic functions, the reciprocal function A14 plot and interpret graphs of non-standard functions in real contexts to find approximate solutions to distance, speed and acceleration	**Notation, vocabulary and manipulation** A1 use and interpret algebraic conventions, including: • ab in place of a × b • 3y in place of y + y + y and 3 × y • a^2 in place of a × a,etc. A2 substitute into scientific formulae A4 simplify and manipulate algebraic expressions including surds and algebraic fractions. A6 use algebra to support and construct arguments and proofs A7 interpret the reverse process as the 'inverse function'; interpret the succession of two functions as a 'composite function' **Graphs** A9 use the form y = mx + c to identify parallel and perpendicular lines A11 identify turning pointsof a quadratic graph by completing the square A12 recognise, sketch and interpret graphs of, exponential functions (y = kx) for positive values of k, and the trigonometric functions(y = sin x, y = cos x and y = tan x) for angles of any size A13 sketch translations and reflections of a given function

Key Stage 4- Algebra continued

Entry Level- learners working below GCSE level	**Functional Skills-** interlink with Foundation FS 1 / FS 2	**Foundation** Review of KS3 and linked with Functional skills	**Higher-** developing skills from Foundation for most able
	NS5 Use simple formulae expressed in words for one or two-step operations	**Solving equations and inequalities** A17 solve linear equations in one unknown algebraically ;find approximate solutions using a graph A18 solve quadratic equations algebraically by factorising; find approximate solutions using a graph A19 solve two simultaneous equations in two variables and find solutions using a graph A21 create algebraic expressions or formulae; A22 solve linear inequalities in one variable; represent the solution set on a number line **Sequences** A23 generate terms of a sequence from either a term-to-term or a position-toterm rule A24 recognise and use sequences of triangular, square and cube numbers, simple arithmetic progressions, Fibonacci type sequences, quadratic sequences, and simple geometric progressions A25 calculate the nth term of linear sequences	**Solving equations and inequalities** A17 solve linear equations with the unknown on both sides of the equation; find approximate solutions using a graph A18 solve quadratic equations (including those that require rearrangement) algebraically by factorising, by completing the square and by using the quadratic formula; find approximate solutions using a graph A19 solve two simultaneous equations with two unknown values (linear/linear or linear/quadratic) algebraically; find approximate solutions using a graph A20 find approximate solutions to equations numerically using iteration A22 solve linear inequalities with one or two unknown value(s) **Sequences** A24 recognise and use sequences of simple geometric progressions (rn where n is an integer, and r is a rational number > 0 or a surd) and other sequences A25 write expressions to calculate the nth term of linear and quadratic sequences

Key Stage 4- Ratio, proportion and rates of change

Entry Level- learners working below GCSE level	**Functional Skills-** interlink with Foundation FS 1 / FS 2	**Foundation** Review of KS3 and linked with Functional skills	**Higher-** developing skills from Foundation for most able
Component 4 To recognise and identify coins and notes and appreciate the purchasing power of the different amounts. To be able to convert from pence to pounds and vice versa and use correct decimal notation including calculator interpretation.	M11 Convert between metric and imperial units of length, weight and capacity using a) a conversion factor and b) a conversion graph tax and simple budgeting NS28 Understand and calculate using ratios, direct proportion and inverse proportion M1 Calculate simple interest in multiples of 5% on amounts of money M2 Calculate discounts in multiples of 5% on amounts of money NS14 Calculate percentages of quantities, including simple percentage increases and decreases by 5% and multiples thereof M10 Calculate amounts of money, compound interest, percentage increases, decreases and discounts including M12 Calculate using compound measures including speed, density and rates of pay	R1 Change freely between related standard units and compound units in numerical and algebraic contexts R2 Use scale factors, scale diagrams and maps R3 Express one quantity as a fraction of another, R4 Use ratio notation, including reduction to simplest form R5 Divide a given quantity into two parts in a given part:part or part:whole ratio; express the division of a quantity into two parts as a ratio; apply ratio to real contexts and problems R6 Express a multiplicative relationship between two quantities as a ratio or a fraction R7 Understand and use proportion as equality of ratios R8 Relate ratios to fractions and to linear functions R9 Define percentage as 'number of parts per 100'; interpret percentages and percentage changes as a fraction or a decimal; express one quantity as a percentage of another; work with percentages greater than 100%; solve problems involving percentage change, including percentage increase/decrease, and simple interest R10 Solve problems involving direct and inverse proportion, including graphical and algebraic R11 Use compound units such as speed, rates of pay, unit pricing, density and pressure R12 Compare lengths, areas and volumes using ratio notation; make links to similarity and scale factors R13 Understand that X is inversely proportional to Y is equivalent to X is proportional to 1/Y ; R14 Interpret the gradient of a straight line graph as a rate of change; recognise and interpret graphs that illustrate direct and inverse proportion R16 Set up, solve and interpret the answers in growth and decay problems, including compound interest	R15 Understand that the gradient at a point on a curve gives the instantaneous rate of change; apply the concepts of average and instantaneous rate of change in numerical, algebraic and graphical contexts R16 including iterative processes

Key Stage 4- Geometry and measures

Entry Level- learners working below GCSE level	**Functional Skills-** interlink with Foundation FS 1 / FS 2	**Foundation** Review of KS3 and linked with Functional skills	**Higher-** developing skills from Foundation for most able
Component 7 -To be able to recognise and name 2D and 3D shapes, including nets of cubes and cuboids. -To be able to describe properties of shapes and understand the key words. -To be able to show symmetry on shapes. -To be able to understand what an angle is, identify a right angle, and identify if an angle is bigger or smaller than a right angle. -To be able to identify horizontal vertical and parallel lines. -To be able to identify and denote co-ordinates on a grid. -To be able to use compass points to give directions from a map.		**Properties & constructions** G1 Use conventional terms and notations: points, lines, vertices, edges, planes, parallel lines, perpendicular lines, right angles, polygons, regular polygons and polygons with reflection and/or rotation symmetries; use the standard conventions for labelling and referring to the sides and angles of triangles; draw diagrams from written description G2 Use the standard ruler and compass constructions; use these to construct given figures and solve loci problems; know that the perpendicular distance from a point to a line is the shortest distance to the line G3 Apply the properties of angles at a point, angles at a point on a straight line, vertically opposite angles; understand and use alternate and corresponding angles on parallel lines; derive and use the sum of angles in a triangle G4 Derive and apply the properties and definitions of: special types of quadrilaterals, including square, rectangle, parallelogram, trapezium, kite and rhombus; and triangles and other plane figures using appropriate language G5 use the basic congruence criteria for triangles (SSS, SAS, ASA, RHS) G6 Apply angle facts, triangle congruence, similarity and properties of quadrilaterals to conjecture and derive results about angles and sides, including Pythagoras' theorem and the fact that the base angles of an isosceles triangle are equal, and use known results to obtain simple proofs G7identify, describe and construct congruent and similar shapes, including on coordinate axes, by considering rotation, reflection, translation and enlargement (including fractional **and negative** scale factors)	**Properties & constructions** G8 Describe the changes and invariance achieved by combinations of rotations, reflections and translations G10 Apply and prove the standard circle theorems concerning angles, radii, tangents and chords, and use them to prove related results

Key Stage 4- Geometry and measures continued

Entry Level- learners working below GCSE level	**Functional Skills-** interlink with Foundation FS 1 / FS 2	**Foundation** Review of KS3 and linked with Functional skills	**Higher-** developing skills from Foundation for most able
		G9 Identify and apply circle definitions and properties, including: centre, radius, chord, diameter, circumference, tangent, arc, sector and segment G11 Solve geometrical problems on coordinate axes G12 Identify properties of the faces, surfaces, edges and vertices of: cubes, cuboids, prisms, cylinders, pyramids, cones and spheres G13 Construct and interpret plans and elevations of 3D shapes	

Key Stage 4- Geometry and measures continued

Entry Level- learners working below GCSE level	**Functional Skills-** interlink with Foundation FS 1 / FS 2	**Foundation** Review of KS3 and linked with Functional skills	**Higher-** developing skills from Foundation for most able
Component 6 -To be able to choose appropriate units, compare, order and add length, height, weight and capacity. -To be able to accurately draw and measure lengths including perimeter and estimate weight and capacity. To be able to read values from a scale including negative temperatures. Component 5 Calendar and time - To be able to know and order days, months and seasons and to know how many days, weeks in a month and a year. - To be able to tell the time from an analogue or digital clock and convert between 12 and 24hr. - To have an understanding of how many seconds, minutes and hours are equal to and convert between them. - To be able to find the difference between two times and add up to three lengths of time given in minutes and hours.	M3 Convert between units of length, weight, capacity, money and time, in the same system M4 Recognise and make use of simple scales on maps and drawings M5 Calculate the area and perimeter of simple shapes including those that are made up of a combination of rectangles M6 Calculate the volumes of cubes and cuboids M7 Draw 2-D shapes and demonstrate an understanding of line symmetry and knowledge of the relative size of angles M8 Interpret plans, elevations and nets of simple 3-D shapes M9 Use angles when describing position and direction, and measure angles in degrees M13 Calculate perimeters and areas of 2-D shapes including triangles and circles and composite shapes including non-rectangular shapes M14 Use formulae to find volumes and surface areas of 3-D shapes including cylinders (formulae to be given for 3-D shapes other than cylinders) M15 Calculate actual dimensions from scale drawings and create a scale diagram given actual measurements M16 Use coordinates in 2-D, positive and negative, to specify the positions of points M17 Understand and use common 2-D representations of 3-D objects M18 Draw 3-D shapes including plans and elevations M19 Calculate values of angles and/or coordinates with 2-D and 3-D shapes	**Mensuration & calculation** G14 Use standard units of measure and related concepts G15 Measure line segments and angles in geometric figures, including interpreting maps and scale drawings and use of bearings G16 Know and apply formulae to calculate: area of triangles, parallelograms, trapezia; volume of cuboids prisms G17 Know the formulae: circumference of a circle , area of a circle; calculate: perimeters of 2D shapes, including circles; areas of circles and composite shapes; surface area and volume of spheres, pyramids, cones and composite solids G18 Calculate arc lengths, angles and areas of sectors of circles G19 Apply the concepts of congruence/similarity, inc lengths, areas and volumes in similar figures G20 Know the formulae for: Pythagoras' theorem and the trigonometric ratios,; apply them to find angles and lengths in right-angled triangles and, where possible, general triangles in two and three dimensional figures G21 Know the exact values of sin θ and cos θ for θ = 0°, 30°, 45°, 60° and 90°; know the exact value of tan θ for θ = 0°, 30°, 45° and 60° **Vectors** G24 describe translations as 2D vectors G25 apply addition and subtraction of vectors, multiplication of vectors by a scalar, and diagrammatic and column representations of vectors	**Mensuration & calculation** G22 know and apply the sine rule: $a/\sin A = b/\sin B = c/\sin C$, and cosine rule: $a^2 = b^2 + c^2 - 2bc \cos A$, to find unknown lengths and angles in non right-angled triangles G23 Know and apply the formula Area = ½ ab sinC to calculate the area, sides or angles of any triangle **Vectors** G25 use vectors to form arguments and proofsin relation to geometric problems

Key Stage 4- Probability

Entry Level- learners working below GCSE level	**Functional Skills-** interlink with Foundation FS 1 / FS 2	**Foundation** Review of KS3 and linked with Functional skills	**Higher-** developing skills from Foundation for most able
	H4 Understand probability on a scale from 0 (impossible) to 1 (certain) and use probabilities to compare the likelihood of events H5 Use equally likely outcomes to find the probabilities of simple events and express them as fractions H9 Work out the probability of combined events including the use of diagrams and tables, including two-way tables H10 Express probabilities as fractions, decimals and percentages H11 Draw and interpret scatter diagrams and recognise positive and negative correlation	P1 Record, describe and analyse the frequency of outcomes of probability experiments using tables and frequency trees P2 Apply ideas of randomness, fairness and equally likely events to calculate expected outcomes of multiple future experiments P3 Relate relative expected frequencies to theoretical probability, using appropriate language and the 0-1 probability scale P4 Apply the property that the probabilities of an exhaustive set of outcomes sum to one; apply the property that the probabilities of an exhaustive set of mutually exclusive events sum to one P5 Understand that empirical unbiased samples tend towards theoretical probability distributions, with increasing sample size P6 Enumerate sets and combinations of sets systematically, using tables, grids, Venn diagrams and tree diagrams P7 Construct theoretical possibility spaces for single and combined experiments with equally likely outcomes and use these to calculate theoretical probabilities P8Calculate the probability of independent and dependent combined events, including using tree diagrams and other representations	P9 Use expected frequencies with two-way tables, tree diagrams and Venn diagrams to calculate and interpret conditional probabilities

Key Stage 4- Statistics

Entry Level- learners working below GCSE level	**Functional Skills-** interlink with Foundation FS 1 / FS 2	**Foundation** Review of KS3 and linked with Functional skills	**Higher-** developing skills from Foundation for most able
Component 8 - To be able to sort and classify objects using one or more criterion. -To be able to collect information and record results using lists and tally charts. -To be able to construct, interpret and compare pictograms and bar charts and use them to extract numerical information. -To solve one-step and two-step problems based on statistical information.	H1 Represent discrete data in tables, diagrams and charts including pie charts, bar charts and line graphs H2 Group discrete data and represent grouped data graphically H3 Find the mean and range of a set of quantities H6 Calculate the median and mode of a set of quantities H7 Estimate the mean of a grouped frequency distribution from discrete data H8 Use the mean, median, mode and range to compare two sets of data	S1 infer properties of populations or distributions from a sample, while knowing the limitations of sampling S2 interpret and construct tables, charts and diagrams, including frequency tables, bar charts, pie charts and pictograms for categorical data, vertical line charts for ungrouped discrete numerical data, tables and line graphs for time series data and know their appropriate use S4 interpret, analyse and compare the distributions of data sets from univariate empirical distributions through: ● appropriate graphical representation involving discrete, continuous and grouped data ● appropriate measures of central tendency (median, mean, mode and modal class) and spread (range, including consideration of outliers) S5 apply statistics to describe a population S6 use and interpret scatter graphs; recognise correlation and know that it does not indicate causation; draw estimated lines of best fit; make predictions; interpolate and extrapolate apparent trends while knowing the dangers of so doing	S3 Construct and interpret diagrams for grouped discrete data and continuous data, i.e. histograms with equal and unequal class intervals and cumulative frequency graphs, and know their appropriate use